

## REMARKS

This paper is submitted in reply to the Final Office Action dated April 30, 2007, within the three-month period for response. In addition, this paper is accompanied by a Request for Continued Examination. Reconsideration and allowance of all pending claims are respectfully requested.

In the subject Office Action, claims 20-23 were rejected under 35 U.S.C. § 101. Furthermore, claims 1-6, 9-15 and 18-24 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,975,447 to Goel et al. in view of U.S. Patent No. 6,757,677 to Pham et al.; and claims 7-8 and 16-17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Goel in view of Pham, and further in view of U.S. Patent No. 5,598,559 to Chaudhuri.

Applicants respectfully traverse the Examiner's rejections to the extent that they are maintained. Applicants have canceled claims 2, 6, 11-12, and 14 and amended claims 1, 4, 7, 10, 13, 18, 20, 22 and 24, and Applicants respectfully submit that no new matter is being added by the above amendments, as the amendments are fully supported in the specification, drawings and claims as originally filed. Applicants also note that the amendments made herein are being made only for facilitating expeditious prosecution of the aforementioned claimed subject matter. Applicants are not conceding in this application that the originally-claimed subject matter is not patentable over the art cited by the Examiner, and Applicants respectfully reserve the right to pursue this and other subject matter in one or more continuation and/or divisional patent applications.

As an initial matter, Applicants wish to thank the Examiner for the consideration extended in the telephonic interview conducted between the Examiner and Applicants' representative on July 2, 2007. In the interview, proposed amendments to the claims to address the Section 101 and 103 rejections were discussed. The Examiner indicated that the amendments would address the Section 101 rejections, and suggested additional clarifying amendments, e.g., that the criteria includes a GROUP BY or ORDER BY clause, and that the modified criteria references one table, that the Examiner believed would further assist in distinguishing the claims from the prior art of record. The

Examiner also agreed to contact the undersigned should any additional amendments be required prior to allowing the case.

Now turning to the subject Office Action, and specifically to the § 101 rejection of claims 20-23, the Examiner will note that Applicants have amended claims 20 and 22 to recite a "recordable physical, computer readable storage medium," support for which may be found in the Application at page 13, lines 10-12. It is Applicants' understanding from the interview that the Examiner considers the amendments to place these claims in statutory form. Withdrawal of the § 101 rejections is therefore respectfully requested.

Next, turning to the art-based rejections, and more specifically to the rejection of independent claim 1, this claim as amended generally recites a method for optimizing a database query, where the database query includes criteria that references a plurality of tables in order to re-order a result set generated for the database query, where the criteria is one of a GROUP BY clause and an ORDER BY clause. The method includes applying transitive closure analysis to at least one search condition in the query to identify an equivalent field for a field referenced in the criteria, and based on the transitive closure analysis, rewriting the criteria to generate modified criteria to reduce the number of tables referenced thereby by substituting the equivalent field for the field referenced in the criteria, including rewriting the criteria to generate modified criteria that references only one table, based on the transitive closure analysis. Claims 2 and 6 have been canceled and claim 7 has been amended for consistency with the amendments to claim 1.

In rejecting claim 1, the Examiner relies on Goel and Pham. The Examiner asserts that Goel discloses applying transitive closure analysis to a query at col. 3, lines 26-30. The Examiner admits, however, that Goel does not disclose rewriting a query to generate modified criteria to reduce the number of tables referenced thereby. For this, the Examiner cites Pham, and in particular the abstract, col. 2, lines 35-48 and col. 9, lines 9-13, for allegedly disclosing this latter feature.

It is important to note, however, that claim 1 recites in part that transitive closure analysis is applied to a search condition in the query, and is used to identify an equivalent field for a field referenced in the criteria. A search condition is described, for example, at

page 10, lines 6-9 and page 14, lines 16-21 of the Application, and includes various conditions that are used to search, or select, records from a database table. Transitive closure analysis can be used to analyze these search conditions to identify equivalent search fields. In the example shown at page 14, lines 11-14, for example, transitive closure analysis performed on the search conditions “X.f1=Y.f1” and “Y.f1=Z.f2” is used to determine that field Z.f2 is equivalent to field X.f1.

Claim 1 also recites in part that a criteria, which is either a GROUP BY clause or an ORDER BY clause, may be modified to reduce the number of tables referenced thereby to only one table by substituting an equivalent field for a field referenced in the criteria. In the example shown at page 14, lines 11-14, for example, knowing that field Z.f2 is equivalent to field X.f1 enables the GROUP BY clause “GROUP BY X.f3, Z.f2” to be rewritten as “GROUP BY X.f3, X.f1,” and so that only Table X is referenced in the clause. By doing so, performance can be improved, e.g., by using an index over the table and avoiding the use of a temporary file.

Goel generally discloses the use of transitive closure analysis in SQL queries, including queries including selection, projection, join, outer join, and intersection operations. As the Examiner correctly notes, however, Goel does not disclose rewriting a criteria such as a GROUP BY or ORDER BY clause that re-orders a result set based upon transitive closure analysis to reduce the number of tables referenced by the criteria, or doing so by substituting an equivalent field for a field referenced in the criteria as determined via transitive closure analysis.

Pham, however, does not remedy this shortcoming of Goel. Pham does disclose the optimization of queries including GROUP BY clauses; however, there is no disclosure of applying transitive closure analysis to search conditions, nor substituting equivalent fields for fields identified in a GROUP BY or ORDER BY clause in order to reduce the number of tables referenced by such a clause. The passages in the abstract and at col. 1, lines 47-53, among others, do disclose reducing the number of rows of a table by performing a partial group-by; however, there is nothing in the reference that refers to reducing the number of tables referenced by a GROUP BY clause.

While Goel and Pham both generally attempt to optimize queries with GROUP BY clauses, neither reference, alone or in combination, discloses or suggests rewriting a GROUP BY clause, or any other criteria that re-orders a result set, to reduce the number of tables referenced by that criteria. Moreover, neither reference discloses or suggests doing so through the use of transitive closure analysis, or through the substitution of a field in a GROUP BY clause with an equivalent field as determined by applying transitive closure analysis to a search condition in a query. Indeed, Applicants cannot even find any disclosure in either reference directed to rewriting any criteria that re-orders a result set. Applicants accordingly submit that the combination proposed by the Examiner does not disclose or suggest each and every limitation of claim 1, so the rejection of claim 1 should be withdrawn.

In the Final Office Action, the Examiner attempts to address Applicants' prior arguments by arguing that the two representations of Query 1 in Pham, found at col. 5, lines 26-33 and 47-63, illustrate the rewriting of a query to reduce the number of tables referenced thereby. The Examiner's reliance on these two representations, however, is incorrect, as it is apparent from a reading of the reference that the representation at lines 26-33 is the original representation that is subsequently modified to the form shown at lines 47-63, which is opposite to that assumed by the Examiner in the arguments presented at page 14 of the Final Office Action. Contrary to the Examiner's arguments, the representation shown at lines 47-63 is not ever rewritten in Pham to create the representation at lines 26-33, much less to do so for the purpose of reducing the number of tables referenced by the GROUP BY clause.

Applicants can find no instance in either Goel or Pham in which field referenced in a GROUP BY or ORDER BY clause is replaced with an equivalent field that is identified through transitive closure analysis of a search condition, nor can Applicants find any instance in either reference in which a field referenced in a GROUP BY or ORDER BY clause that originally references multiple tables is replaced such that only one table is referenced by the clause.

Applicants therefore respectfully submit that independent claim 1 is non-obvious over Goel and Pham. Reconsideration and allowance of claim 1, and of claims 3-5 and 7-9 which depend therefrom, are therefore respectfully requested.

Next, turning to the rejection of independent claim 10, this claim as amended generally recites a method of optimizing a database query, where the database query includes criteria that operates to re-order a result set of the database query and requires creating a temporary file during operation, and where the criteria is one of a GROUP BY clause and an ORDER BY clause. The method includes applying transitive closure analysis to at least one search condition in the query to identify an equivalent field for a field referenced in the criteria, and rewriting the criteria, based on the transitive closure analysis, to generate a modified criteria by substituting the equivalent field for the field referenced in the criteria. The criteria references a plurality of tables and the modified criteria references a single table, and the modified criteria operates to re-order a result set of the database query and avoid creating a temporary file during operation. Claims 11 and 12 were canceled for consistency with the amendments to claim 10.

In rejecting claim 10, the Examiner again relies on Goel and Pham. As with claim 1, however, Goel and Pham do not disclose a number of features recited in claim 10. Notably, neither reference discloses or suggests applying transitive closure analysis to a search condition in a query, and for the purpose of identifying an equivalent field for a field referenced in a GROUP BY or ORDER BY clause. Likewise, neither reference discloses or suggests rewriting a GROUP BY clause, or any other criteria that re-orders a result set, to reduce the number of tables referenced by that criteria, or to avoid the creation of a temporary file during operation.

Goel, as acknowledged by the Examiner, does not disclose rewriting a criteria that re-orders a result set based upon transitive closure analysis to avoid creating a temporary file. Pham, however, does not remedy this shortcoming of Goel. Pham does disclose the optimization of queries including GROUP BY clauses; however, there is no disclosure of applying transitive closure analysis to search conditions, nor of doing so for the purpose of avoiding the creation of a temporary file. None of the cited passages in Pham, in

particular, disclose any elimination of a temporary file through rewriting any portion of a query.

In the Final Office Action, the Examiner attempts to address Applicants' prior arguments by arguing that the two representations of Query 1 in Pham, found at col. 5, lines 26-33 and 47-63, illustrate the rewriting of a query to reduce the number of tables referenced thereby. As noted above, however, the representation shown at lines 26-33 is capable of being rewritten to that shown at lines 47-63, but not vice versa. The Examiner's argument on eliminating a temporary file is based upon a reading of a rewriting occurring from the representation shown at lines 47-63 to that shown at lines 26-33; however, this reading is not supported by the teachings of Pham as a whole. Indeed, it appears that Pham actually increases the number of temporary files (referred to as "views" in Pham) created during execution of the query shown at lines 26-33.

While Goel and Pham both generally attempt to optimize queries with GROUP BY clauses, neither reference, alone or in combination, discloses or suggests rewriting a GROUP BY clause, or any other criteria that re-orders a result set, to avoid the creation of a temporary file. Moreover, neither reference discloses or suggests doing so through the use of transitive closure analysis performed on a search condition in a query and used to identify an equivalent field that can be substituted for a field in the clause. Applicants accordingly submit that the combination proposed by the Examiner does not disclose or suggest each and every limitation of claim 10, so the rejection of claim 10 should be withdrawn. Reconsideration and allowance of claim 10 are therefore respectfully requested.

Next, with regard to the Examiner's rejection of independent claim 13, this claim generally recites a method for optimizing a database query, where the database query involves a plurality of join operations and a plurality of search conditions. The method includes applying transitive closure analysis to the plurality of search conditions in the query to determine a subset of equivalent search fields, rewriting a criteria, that operates to re-order a result set of the database query, to generate a set of respective modified criteria that each reference one or more equivalent search fields, where the criteria is one

of a GROUP BY clause and an ORDER BY clause, and selecting a join order from among a plurality of join orders for the plurality of join operations, including analyzing join orders using at least one of the set of respective modified criteria.

In rejecting claim 13, the Examiner again relies on Goel and Pham. The Examiner asserts that Goel discloses applying transitive closure analysis to a query at col. 3, lines 26-30. The Examiner admits, however, that Goel does not disclose rewriting a criteria, that operates to re-order a result set of the database query, to generate a set of respective modified criteria that each reference one or more equivalent search fields. For this, the Examiner cites Pham, and in particular the abstract, col. 2, lines 35-48, and col. 9, lines 9-13, for allegedly disclosing this latter feature.

At nowhere in any of the cited passages of Pham, however, is there any discussion or suggestion of rewriting a criteria that operates to re-order a result set, much less doing so to generate a set of modified criteria that each reference one or more equivalent search fields, as required by claim 13. The cited passages discuss the use of partial group-by operators; however, Applicants can find no reference to modifying a criteria in a query that re-orders a result set. In addition, Applicants can find no reference to rewriting any portion of a query to reference equivalent search fields, much less to do so based upon transitive closure analysis that determines equivalent search fields. Other than the fact that Goel mentions transitive closure analysis, and Pham discloses group-by operators, Applicants can find no relevance for either reference with respect to the limitations of claim 13.

In the Final Office Action, the Examiner attempts to address Applicants' prior arguments by arguing that the two representations of Query 1 in Pham, found at col. 5, lines 26-33 and 47-63, illustrate the rewriting of a query to reduce the number of tables referenced thereby. As noted above, however, the representation shown at lines 26-33 is capable of being rewritten to that shown at lines 47-63, but not vice versa. The Examiner's argument on reducing the number of tables is based upon a reading of a rewriting occurring from the representation shown at lines 47-63 to that shown at lines 26-33; however, this reading is not supported by the teachings of Pham as a whole. In

addition, Applicants still can find no disclosure in the cited passages of generating a set of modified criteria, or of selecting a join order from among a plurality of join orders for the plurality of join operations by analyzing join orders using at least one of the set of respective modified criteria.

As discussed at page 16 of the Application, join orders are typically locked to start with a particular table whenever a GROUP BY or ORDER BY clause is present that references the table and is implemented by an index. As such, the number of potential join orders that may be tried during optimization may be constrained. By replacing fields in a GROUP BY or ORDER BY clause with equivalent fields as determined through transitive closure analysis, additional join orders may be tried, leading to the potential for finding a more optimal query implementation. Neither Goel nor Pham appreciates this feature, nor that a set of modified criteria may be generated to enable different join orders to be analyzed. Accordingly, Applicants submit that claim 13 is non-obvious over Goel and Pham. Reconsideration and allowance of claim 13, and of claims 15-19 which depend therefrom, are therefore respectfully requested.

Next, with respect to independent claims 20 and 24, these claims have been amended in a similar manner to claim 1, and as such, are patentable over Goel and Pham for the same reasons as claim 1. Likewise, claim 22 has been amended in a similar manner to claim 13, and as such, this claim is patentable over Goel and Pham for the same reasons as claim 13. Reconsideration and allowance of claims 20, 22 and 24, and of claims 21 and 23 which depend therefrom, are therefore respectfully requested.

As a final matter, Applicants traverse the Examiner's rejections of the dependent claims based upon their dependency on the aforementioned independent claims. Nonetheless, Applicants note that a number of these claims recite additional features that further distinguish these claims from the references cited by the Examiner. As but one example, claim 4 has been amended to clarify that a first search condition in a query searches on a match between a first field and a second field, and a second search condition in the query searches on a match between the second field and a third field. The claim also clarifies that applying transitive closure analysis includes determining that



the third field is equivalent to the second field in the criteria. Support for this amendment may be found, for example, at page 14, lines 16-27 of the Application. Applicants can find no disclosure in either Goel or Pham that is even arguably relevant to these additional claimed features in claim 4.

In summary, Applicants respectfully submit that all pending claims are novel and non-obvious over the prior art of record. Reconsideration and allowance of all pending claims are therefore respectfully requested. If the Examiner has any questions regarding the foregoing, or which might otherwise further this case onto allowance, the Examiner may contact the undersigned at (513) 241-2324. Moreover, if any other charges or credits are necessary to complete this communication, please apply them to Deposit Account 23-3000.

Respectfully submitted,

July 5, 2007  
Date

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